

# Heterotopic bone formation in abdominal incisions

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*Heterotopic bone formation in vertical abdominal wounds is a not infrequent and sometimes disabling complication of abdominal surgery, occurring predominantly in males. Excision of the bone is indicated only for marked discomfort or pain, usually produced by an active lifestyle. Under these circumstances, recurrence of bone following excision, would be highly undesirable and the prophylactic use of etidronate disodium may well be indicated to prevent new bone formation, as demonstrated by one of our cases (Case 8).*

## Introduction

Heterotopic bone formation in scars of abdominal incisions is not a rare occurrence, yet few reports are present in the literature<sup>1-9</sup>. We report 8 recent cases, all males, in one of whom the bone recurred after excision; in another, prophylactic treatment was given to prevent recurrence of bone formation in the surgical wound, using etidronate disodium (EHDP: Didronel). We present a review of the literature regarding heterotopic bone formation in abdominal wounds, indications for surgery and possible uses of EHDP.

## Case reports

### Case 1

A 53-year-old white male health professional underwent a subtotal gastrectomy for adenocarcinoma of the stomach, through a vertical incision. Two years later the patient died from metastatic disease. At autopsy, heterotopic bone formation was present in his abdominal scar.

### Case 2

A 72-year-old retired white man underwent a partial colectomy for adenocarcinoma of the colon, through a vertical incision. Four months later bone formation was discovered in the scar and was surgically excised.

### Case 3

A 45-year-old disabled white male laborer underwent vagotomy and pyloroplasty for intractable duodenal ulcer,

through an upper midline incision. At the postoperative visit, induration was noted in the wound, which progressed to radiologically proven bone. His lifestyle was not hindered by the bone, which was thus left alone and has not changed in 3 years.

### Case 4

A 69-year-old retired white man underwent palliative esophagectomy for advanced adenocarcinoma arising in Barrett's esophagus, through an upper midline and a separate right thoracic incision. Six weeks later bone 5 cm long was noted in the upper part of the vertical midline incision. This did not hinder him and was left alone.

### Case 5

A 44-year-old white truck driver underwent a vagotomy, pyloroplasty and fundoplication for severe acid-pepsin disease, plus esophagitis. After several months, he was noted to have a piece of bone 3 x 2 cm in size at the upper end of his wound, near the xiphoid process. This did not progress nor interfere with his activities and was left alone.

### Case 6

A 70-year-old retired white man underwent a high partial gastrectomy for gastric lymphoma. Two months later, in follow-up, he was noted to have a piece of bone about 5 cm long by 2-3 cm wide in the upper part of his abdominal scar. His main activity was walking and the bone did not hinder him, so it was left alone.

### Case 7

A 40-year-old white laborer underwent drainage of a pancreatic pseudocyst through an upper midline incision. Bone formation was noted 3 weeks later in the scar. The bone was 10 cm long and bowed anteriorly, extending from xiphoid to umbilicus. As he became more active, it hindered his activities and was excised. The bone recurred but was only about 5 cm in length and no further surgery was performed.

### Case 8

A 49-year-old white male plasterer underwent a cholecystectomy, appendectomy and repair of an umbilical hernia through an upper midline incision. Bone formation was noted 3 weeks later in the scar. The bone was large (6 x 4 x 3 cm), bowed forward, and continuous with the xiphoid process. The bone interfered mechanically with movement and was painful

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**Carcinogenesis, Mutagenesis, Impairment of Fertility**—A 2-year oral carcinogenicity study in rats with doses as high as 500 mg/kg/day (about 80 times the recommended daily therapeutic dose) showed no evidence of a carcinogenic effect. There was a dose-related increase in the density of enterochromaffin-like (ECL) cells in the gastric oxyntic mucosa. In a 2-year study in mice, there was no evidence of a carcinogenic effect in male mice, although hyperplastic nodules of the liver were increased in the high-dose males as compared with placebo. Female mice given the high dose of Axid (2,000 mg/kg/day, about 330 times the human dose) showed marginally statistically significant increases in hepatic carcinoma and hepatic nodular hyperplasia with no numerical increase seen in any of the other dose groups. The rate of hepatic carcinoma in the high-dose animals was within the historical control limits seen for the strain of mice used. The female mice were given a dose larger than the maximum tolerated dose, as indicated by excessive (30%) weight decrement as compared with concurrent controls and evidence of mild liver injury (transaminase elevations). The occurrence of a marginal finding at high dose only in animals given an excessive and somewhat hepatotoxic dose, with no evidence of a carcinogenic effect in rats, male mice, and female mice (given up to 360 mg/kg/day, about 60 times the human dose), and a negative mutagenicity battery are not considered evidence of a carcinogenic potential for Axid.

Axid was not mutagenic in a battery of tests performed to evaluate its potential genetic toxicity, including bacterial mutation tests, unscheduled DNA synthesis, sister chromatid exchange, mouse lymphoma assay, chromosome aberration tests, and a micronucleus test.

In a 2-generation, perinatal and postnatal fertility study in rats, doses of nizatidine up to 650 mg/kg/day produced no adverse effects on the reproductive performance of parental animals or their progeny.

**Pregnancy—Teratogenic Effects—Pregnancy Category C**—Oral reproduction studies in rats at doses up to 300 times the human dose and in Dutch Belted rabbits at doses up to 55 times the human dose revealed no evidence of impaired fertility or teratogenic effect; but, at a dose equivalent to 300 times the human dose, treated rabbits had abortions, decreased number of live fetuses, and depressed fetal weights. On intravenous administration to pregnant New Zealand White rabbits, nizatidine at 20 mg/kg produced cardiac enlargement, coarctation of the aortic arch, and cutaneous edema in 1 fetus, and at 50 mg/kg, it produced ventricular anomaly, distended abdomen, spina bifida, hydrocephaly, and enlarged heart in 1 fetus. There are, however, no adequate and well-controlled studies in pregnant women. It is also not known whether nizatidine can cause fetal harm when administered to a pregnant woman or can affect reproduction capacity. Nizatidine should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

**Nursing Mothers**—Studies in lactating women have shown that 0.1% of an oral dose is secreted in human milk in proportion to plasma concentrations. Because of growth depression in pups reared by treated lactating rats, a decision should be made whether to discontinue nursing or the drug, taking into account the importance of the drug to the mother.

**Pediatric Use**—Safety and effectiveness in children have not been established.

**Use in Elderly Patients**—Healing rates in elderly patients were similar to those in younger age groups as were the rates of adverse events and laboratory test abnormalities. Age alone may not be an important factor in the disposition of nizatidine. Elderly patients may have reduced renal function.

**Adverse Reactions:** Worldwide, controlled clinical trials included over 6,000 patients given nizatidine in studies of varying durations. Placebo-controlled trials in the United States and Canada included over 2,600 patients given nizatidine and over 1,700 given placebo. Among the adverse events in these placebo-controlled trials, only anemia (0.2% vs 0%) and urticaria (0.5% vs 0.1%) were significantly more common in the nizatidine group. Of the adverse events that occurred at a frequency of 1% or more, there was no statistically significant difference between Axid and placebo in the incidence of any of these events (see package insert for complete information).

A variety of less common events were also reported; it was not possible to determine whether these were caused by nizatidine.

**Hepatic**—Hepatocellular injury (elevated liver enzyme tests or alkaline phosphatase) possibly or probably related to nizatidine occurred in some patients. In some cases, there was marked elevation (>500 IU/L) in SGOT or SGPT and, in a single instance, SGPT was >2,000 IU/L. The incidence of elevated liver enzymes overall and elevations of up to 3 times the upper limit of normal, however, did not significantly differ from that in placebo patients. All abnormalities were reversible after discontinuation of Axid. Since market introduction, hepatitis and jaundice have been reported. Rare cases of cholestatic or mixed hepatocellular and cholestatic injury with jaundice have been reported with reversal of the abnormalities after discontinuation of Axid.

**Cardiovascular**—In clinical pharmacology studies, short episodes of asymptomatic ventricular tachycardia occurred in 2 individuals administered Axid and in 3 untreated subjects.

**CNS**—Rare cases of reversible mental confusion have been reported.

**Endocrine**—Clinical pharmacology studies and controlled clinical trials showed no evidence of anti-androgenic activity due to nizatidine. Impotence and decreased libido were reported with similar frequency by patients on nizatidine and those on placebo. Gynecomastia has been reported rarely.

**Hematologic**—Anemia was reported significantly more frequently in nizatidine than in placebo-treated patients. Fatal thrombocytopenia was reported in a patient treated with nizatidine and another H<sub>2</sub>-receptor antagonist. This patient had previously experienced thrombocytopenia while taking other drugs. Rare cases of thrombocytopenic purpura have been reported.

**Integumentary**—Urticaria was reported significantly more frequently in nizatidine- than in placebo-treated patients. Rash and exfoliative dermatitis were also reported.

**Hypersensitivity**—As with other H<sub>2</sub>-receptor antagonists, rare cases of anaphylaxis following nizatidine administration have been reported. Rare episodes of hypersensitivity reactions (eg, bronchospasm, laryngeal edema, rash, and eosinophilia) have been reported.

**Other**—Hyperuricemia unassociated with gout or nephrolithiasis was reported. Eosinophilia, fever, and nausea related to nizatidine have been reported.

**Overdosage:** Overdoses of Axid have been reported rarely. If overdosage occurs, activated charcoal, emesis, or lavage should be considered along with clinical monitoring and supportive therapy. The ability of hemodialysis to remove nizatidine from the body has not been conclusively demonstrated; however, due to its large volume of distribution, nizatidine is not expected to be efficiently removed from the body by this method. PV 2093 AMP (101591)

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## HETEROTOPIC (Continued from page 65)

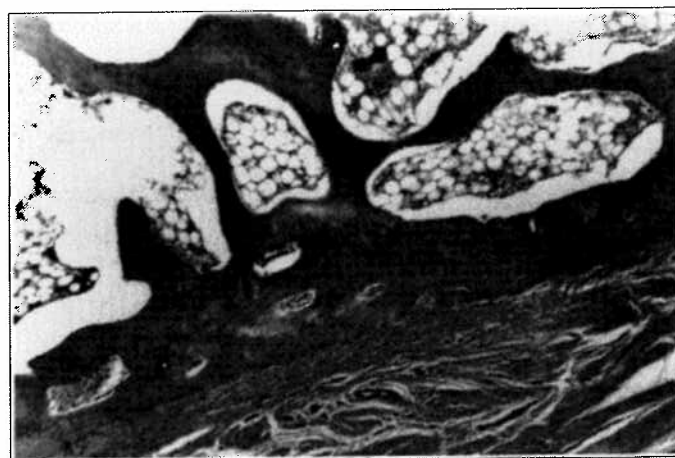


Figure 1: Case 8. Mature lamellar bone with sinuses containing fat and hematopoietic tissue, bordered by dense connective tissue. No cartilage is seen in this particular section. (Decalcified, paraffin-embedded, hematoxylin-eosin stain; magnification x40).

during his work as a plasterer. One month prior to its surgical excision, the patient was placed on a daily regimen of Didronel, 20 mg/kg/day. This dosage was continued for 3 months post-operation. There has been no recurrence of bone in the scar to date, 6 years following the excision.

The patients were of normal weight and not obese. They had no prior history of bone formation in other locations. In all cases the surgical incisions encroached upon the xiphoid process and the heterotopic bone later developed in the upper portions of the scar — in Cases 7 and 8 the heterotopic bone was actually attached to the xiphoid process. The bone varied in length from 3 cm to 10 cm. Otherwise, the scars were formed in a normal fashion.

The bone removed under these circumstances showed no histological difference from other forms of bone and contained lamellar bone, fat and hematopoietic tissue, with varying amounts of cartilage, all bordered by a rim of dense connective tissue. A microscopic section of the bone removed from Case 8 (Fig 1) together with an x-ray of the resected specimen is presented (Fig 2).

## Discussion

Heterotopic bone formation in surgical wounds of the abdomen occurs only in longitudinal incisions (as opposed to horizontal ones)<sup>1-8</sup>, thus implicating the xiphoid process or symphysis pubis as possible progenitors in its pathogenesis. The bone so formed is usually near to one of these structures, positioned between the anterior or posterior rectus sheath and the rectus abdominis muscle<sup>3,5</sup>. It presents itself anywhere from 3 weeks to several years following operations<sup>2,5</sup>.

This bone formation has a distinct male preponderance<sup>1,2,3,5</sup>, in that by 1962 only 5 of the 92 reported cases were in women<sup>9</sup>. This may be due in part to the fact that abdominal operations using longitudinal incisions are probably more common in males, considering the male predilection for peptic ulcer disease, carcinoma of the stomach, bladder and prostate. Abdominal operations in females, such as hysterectomies and Cesarean sections are frequently performed through low hori-

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Figure 2: Case 8. An x-ray of the specimen piece of bone resected from the patient who had been pre-tested with EHDP.

zontal incisions, while cholecystectomies are often performed through oblique transverse subcostal incisions, away from the costal margin. If bone did form in such incisions, it would very likely not inconvenience the patient, and may in fact not even be noticed.

There does not appear to be any evidence of a familial predisposition to this type of bone formation, though it has been reported in 2 brothers during the same time period<sup>1</sup>.

There are basically 2 theories regarding the pathogenesis of heterotopic bone formation in surgical wounds<sup>1-11</sup>. One theory suggests that osteoblasts are derived through metaplasia of multi-potential mesenchymal cells already present in the fascia, or derived from granulation tissue. The second theory postulates that transposition of periosteal or perichondral fragments, disrupted at the time of surgery, will form a nidus for further bone growth. We do not see these processes as mutual-

ly exclusive and it is our belief that either of these modes of bone formation may occur, separately or together, keeping in mind that the linea alba is possibly a vestigial remnant of the sternum. There is no evidence linking heterotopic bone formation to any metabolic or endocrine disorder, nor to the nature of the suture material used<sup>6</sup>.

The cure for heterotopic bone formation in surgical wounds has generally been surgical excision, with occasional postoperative radiation<sup>6,8,9</sup>. However, we now propose a possible preventive measure with the use of etidronate disodium (EHDP). EHDP is the only drug of its class of compounds — biphosphonates (formerly diphosphonates) — currently on the market. Biphosphonates are structural analogs of pyrophosphate, a naturally occurring inhibitor of bone formation. EHDP prevents the conversion of amorphous calcium phosphate to crystalline hydroxyapatite, the mineral component of bone. Furthermore, it also binds to the hydroxyapatite present, rendering it more resistant to chemical attack by alkaline and acid phosphatases produced by the osteoblasts and osteoclasts respectively<sup>12,13</sup>. It thus slows down both the dissolution and the accumulation of mineral. Also, it appears to interfere with the conversion of osteoblasts to osteocytes and markedly reduces the osteoclast population<sup>12,13,14</sup>. Serum calcium and parathyroid hormone levels are not significantly changed<sup>14</sup>, yet in Paget's Disease a marked decrease in both urinary hydroxyproline and serum alkaline phosphatase is noted, reflecting decreased osteoclastic and osteoblastic activity<sup>14,16</sup>. In short, EHDP inhibits both bone remodeling and mineralization.

The principal use of EHDP is in the treatment of Paget's Disease<sup>14-17</sup>. It has also been recommended for heterotopic ossification in patients following severe head or spinal cord injury and following total hip arthroplasty<sup>18,19,20</sup>. EHDP has also been used with varying success in postmenopausal osteoporosis, myositis ossificans progressiva<sup>21,22</sup>, calcinosis universalis<sup>23</sup>, the prevention of periodontitis<sup>24</sup>, and the prevention of calculi in the urinary tract<sup>25</sup>. On an investigational basis, it has been studied for the prevention of atherosclerosis<sup>26</sup>. Recently, the intravenous administration of dichloromethylene diphosphonate (not currently on the market) and EHDP have shown great promise in lowering the serum calcium in patients with hypercalcemia of malignancy<sup>27,28</sup>.

The side effects of EHDP therapy are usually manifested only when large or prolonged doses are administered, consisting of gastrointestinal upsets<sup>14,18</sup>, osteomalacia (with increased likelihood of pathologic fractures)<sup>12,16,17</sup>, hyperphosphatemia<sup>12,14</sup>, and an increase in bone pain<sup>16,18</sup>.

Apart from its primary use in Paget's Disease, EHDP exerts its most beneficial effect in the prevention of heterotopic bone formation before its actual onset, rather than as treatment<sup>18,20</sup>.

Two of our patients (Cases 7 and 8) experienced severe pain and inconvenience from the large ossified fragments in their abdominal wounds. Since in each patient the heterotopic bone was attached to the xiphoid process, there was considerable limitation of their activities as construction workers. It is known that trauma and heavy physical labor can predispose to heterotopic bone formation<sup>2</sup>. With these considerations in mind, and after the bone recurred in Case 7, the next patient (Case 8) received pre- and postoperative EHDP and has not had a recurrence of heterotopic bone formation after 6 years.

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